Appendix N

Water Resources Analysis

Content

Attachments

APPENDIX N
WATER RESOURCES ANALYSIS

N.1 Background

The Canadian National Railway Company and Grand Trunk Corporation (collectively, CN or the Applicants) are seeking authorization from the Surface Transportation Board (STB) to acquire control of EJ&E West Company, a wholly owned non-carrier subsidiary of Elgin, Joliet and Eastern Railway Company (EJ&E). Appendix N discusses SEA's evaluation of potential effects on the water resources resulting from the proposed acquisition.

N.2 Water Resources Methodology

The Applicants are proposing to acquire control of EJ&E West Company and to use the EJ&E rail line to connect all five of CN's rail lines in Chicago (the Proposed Action). The SEA has analyzed the potential effects of the Proposed Action and other alternatives on water and wetland resources and has used the methodology presented herein to estimate the following:

- Consistency with water quality standards
- Wetland impacts
- Floodplain impacts
- Impacts to streams
- Effects on groundwater

N.2.1 Applicable Regulations and Guidance

The methodologies that SEA used to conduct the review of water and wetland resources were in accordance with Federal regulations and guidelines. These regulations include the following: 1) the National Environmental Policy Act of 1969 (NEPA) (42 United States Code [USC] 4321-4347), 2) the Board's regulations (49 Code of Federal Regulations [CFR] 1105), and 3) guidelines published by the Council on Environmental Quality (CEQ) (40 CFR 1500).

SEA analyzed the potential effects of the proposed construction to ensure compliance with other Federal laws including the following:

- Discharges into waters of the U.S. (including wetlands), regulated by Sections 401, 402, and 404 of the Clean Water Act of 1977, as amended by the Water Quality Control Act of 1987 (Public Law [PL] 100-4); National Pollutant Discharge Elimination System (NPDES) (33 USC 1342 *et seq.*); and Executive Order 11990, "Protection of Wetlands" (42 Federal Register [FR] 26961, May 1977)
- Construction activities in navigable waters, regulated by Section 10 of the Rivers and Harbors Act of 1899 (33 USC 403)
- Construction activities located in floodplains, regulated by Executive Order 11988, "Floodplain Management" (May 1977)

SEA also analyzed the potential effects of the proposed construction as it relates to state regulations associated with nationwide permits, including the following:

- Illinois: Rivers, Lakes and Streams Act (615 Illinois Compiled Statutes [ILCS] 5), and Interagency Wetland Policy Act (20 ILCS 830)

- Indiana: Floodplain Management Act (Indiana Code [IC] 14-28-3)

N.2.2 Data Sources

SEA evaluated data from the following sources in the review of potential impacts on water and wetland resources that would result from the Proposed Action:

- U.S. Geological Survey (USGS) 7.5-minute series topographic maps
- U.S. Fish and Wildlife Service (USFWS) National Wetland Inventory (NWI) maps
- Federal Emergency Management Agency (FEMA) Flood Insurance Rate Maps (FIRMs)
- Aerial photographs
- Natural Resources Conservation Service (NRCS) soil surveys and applicable lists of hydric soils
- Aquifer/geological maps
- Internet databases and other pertinent on-line information
- Field investigations of the areas potentially affected by the Proposed Action
- Agency consultation
- Illinois Dept of Natural Resources
- Indiana Dept of Natural Resources
- Illinois Environmental Protection Agency
- Indiana Dept of Environmental Management
- Illinois State Geological Survey
- Illinois State Water Survey
- Barrington Area Council of Governments (BACOG)
- Conceptual drawings of the proposed construction and typical cross sections for various segments of the Proposed Action from the Applicants

N.2.3 Screening Process

SEA evaluated the potential for direct and indirect impacts on water and wetland resources related to the Proposed Action and other alternatives. SEA focused their analysis on the potential impacts on water and wetland resources associated with the Proposed Action, including construction of new rail line connections, and installation of second track (double-tracking).

N.2.4 Analytical Methods

The following sections discuss the assumptions, evaluation criteria, and analysis that SEA followed to evaluate potential effects on water and wetland resources as a result of the Proposed Action.

N.2.4.1 Water Resources and Wetlands

SEA gathered information about existing water resources and wetlands at or near proposed construction areas to evaluate potential effects on these natural resources. The sections below discuss SEA's methods for review of maps, field investigations, permit requirements, and evaluation of potential effects on water resources and wetlands.

Map Review and Analysis

SEA referred to published maps and charts that identify water and wetland resources at or near proposed construction areas. SEA reviewed USGS topographic maps, state and county maps, and aerial photography to locate any surface waters, including intermittent and perennial streams, ponds, and rivers. SEA also examined NWI maps and aerial photographs to determine the potential presence wetlands and hydric soils, SEA reviewed NRCS county soil surveys and hydric soil lists for the potential wetlands. The presence of hydric soils is one of the three indicators of a jurisdictional wetland; the other two indicators are hydrophytic vegetation and wetland hydrology. SEA evaluated maps and published data to characterize the geologic formations in the construction areas and determine the status of the groundwater aquifers, and the location of municipal and private wells in the region.

SEA reviewed FEMA FIRMs of stream in the construction areas to determine if the proposed activities occur within a 100-year floodplain. Because construction activities within a floodplain could potentially affect water quality and flooding characteristics at or near the proposed sites, SEA evaluated potential effects relative to Executive Order 11988, and state floodplain regulations. Additionally, Letters of Map Change (LOMC) were reviewed to determine the limits of the current FEMA designated and regulated 100-year floodplain.

Field Review

SEA visited the proposed construction areas determined to have the most likely potential for impacts on water resources and wetlands. SEA based their determination of site visit locations on indicators from the initial review of the data discussed in Section 1.3, Data Sources.

During the site investigation, SEA observed and documented the characteristics of the natural and man-made environment and determined the potential effects of the proposed construction activities on water resources and wetlands. SEA conducted water resources and wetland site reconnaissance, completed data summaries on standardized data sheets, collected and mapped GPS data, and photographed the sites.

Permits

SEA determined the need for permits based on the information from the reference material, field investigations conducted to identify potential effects on water resources and wetlands, and permit requirements of Sections 401, 402, and 404 of the Clean Water Act and upon consultation with Federal, state, and local water management agencies to determine the requirements for compliance and permit issuance.

Attachment N1

Technical Memo on Hydraulic Impacts on Culverts

ONE COMPANY *Many Solutions*℠

Memo

To:	File		
From:	Matt Redington	Project:	CN EJE - EIS
CC:			
Date:	March 3, 2008	Job No:	74177

RE: CN Environmental Hydraulic Impacts Analysis

<u>Design Approach</u>
The proposed design approach is to extend existing culverts in place. The extensions would be of the same material and size as the existing structure.

<u>Culvert Hydraulics</u>
A culvert can be in either inlet or outlet control. As stated in HDS-5, Hydraulic Design of Highway Culverts (2005), design factors on hydraulic performance are as follows:

Table 1--Factors Influencing Culvert Performance.

Factor	Inlet Control	Outlet Control
Headwater Elevation	X	X
Inlet Area	X	X
Inlet Edge Configuration	X	X
Inlet Shape	X	X
Barrel Roughness		X
Barrel Area		X
Barrel Shape		X
Barrel Length		X
Barrel Slope*		X
Tailwater Elevation		X

*Barrel slope affects inlet control performance to a small degree, but may be neglected.

<u>Inlet Control</u>
In cases where the existing structure is under inlet control, the culvert extension would not appreciably change the headwater at the upstream side of the track because inlet area, inlet edge configuration, and inlet shape would presumably be similar under both existing and proposed conditions. Any change to headwater elevation would be limited primarily to the increase in invert elevation (assuming the culvert was extended in the upstream direction). In such a case, the headwater would increase as follows:

Increase in headwater = extension length x slope of the structure

Aerial photographs can be used to determine existing structure length, and the slope of the structure can be assumed to be the same as the overall channel slope. For the sake of the rough analysis performed in the EIS, it can be assumed that all culverts will be lengthened by 30%.
<u>Outlet Control</u>

In cases where the existing structure is under outlet control, the culvert extension would change the headwater at the upstream side of the track. The change would primarily be due to the increase in friction losses along the length of the culvert barrel. As stated in HDS-5, culvert barrel friction losses are as follows:

Velocity Head = $H_v = v^2/2g$ (HDS-5, equation 3)

Where,
v = velocity of flow in pipe, ft/s
g = 32.2 ft/s^2

Increase in headwater = H_v x $(K_u n^2 L/R^{1.33})$ (HDS-5, equation 4b)

Where,
Ku = constant = 29 (in English units)
n = Manning's roughness coefficient
n = 0.014 (concrete pipe)
n = 0.024 (corrugated metal pipe)
L = length of culvert extension, ft
R = hydraulic radius, ft

In most cases, the velocity for determination of velocity head can be assumed to be the total flow of the watershed divided by the cross sectional area of the existing culvert. In cases where the existing crossing is appropriately designed, this is a reasonable approach and velocities would tend to be in the normal range of 5 to 15 fps. In cases where the culvert capacity is insufficient under existing conditions, the velocity would calculate to an unreasonably high number. In reality, when culverts are undersized, there is often significant backwater and storage on the upstream side of the embankment. In this situation, attenuation (or overtopping) would reduce the flow proceeding through the culvert barrel. This would result in a lower velocity in the barrel than what would be calculated by dividing watershed flow by pipe area. To account for this situation, when velocities are calculated in excess of 20 fps, the velocity should be assumed to be equal to 20 fps.

Conclusion
By determining the increase in headwater due to inlet invert changes and added barrel friction losses, the range of potential water surface elevation increases can be compared and determined.

Limitations
Limitations of this analysis include the following:

- Does not determine implications of the calculated increases to water surface elevation
- Does not take into account storage or attenuation effects upstream of the rail embankment
- Does not include an overtopping analysis
- Does not determine inlet or outlet control
- Not based on field survey or record drawings
- Does not take into account field or plan verified inlet conditions (slope tapered inlet, bell end projecting, etc) so proposed inlet hydraulic performance may differ from existing inlet performance
- Based on assumed lengthening of barrel by 30%

Attachment N2

Technical Memo on CN Hydraulic Analysis

HDR | ONE COMPANY *Many Solutions*℠

Memo

To:	File		
From:	Dan Murphy	Project:	CN EJE - EIS
CC:			
Date:	March 13, 2008	Job No:	74177

RE: CN Hydrologic Analysis

Background

This memo documents the hydrologic analysis performed for the CN EJE – DEIS. This analysis resulted in 100-yr peak flow rates for those hydraulic structures identified as potentially requiring extension in the double track project areas. These flow rates were used for hydraulic analysis described in the memo to file dated 3/3/2008.

Drainage Area Delineation

Rough drainage areas for the entire study area were delineated automatically from USGS Topographic Maps in ArcGIS using the ArcHydro extension. Drainage areas were further refined manually for all identified hydraulic structures in the study area.

Peak Flow Computation

100-yr peak flow rates were computed for all hydraulic structures potentially requiring extension using two methods.

Regression Equation Method

Peak flows for all drainage areas larger than 0.02 square miles utilized regression equations described in "Technique for estimating flood-peak discharges and frequencies on rural streams in Illinois" (Curtis, 1987). The regression equations require four variable inputs for each drainage area: 1) drainage area, in square miles, 2) slope, in feet per mile, 3) rainfall, in inches, which is the 2-yr, 24-hr precipitation depth, and 4) regional factor. Computation of each input is described below:

1) Drainage areas were computed with ArcGIS.

2) Slopes were computed using USGS Topographic Maps or 2 foot county contour data (where available) in ArcGIS using the 10-85 method.

3,4) Rainfall and regional factors were selected for each site using figures in the aforementioned reference. These figures are also available on the web at: http://water.usgs.gov/software/NFF/manual/il/index.html.

Rational Method

Peak flows for drainage areas less than 0.02 square miles were computed using the Rational Method. The Rational Method requires three variable inputs for each drainage area: 1) runoff coefficient, 2) rainfall intensity, in inches per hour, and 3) drainage area, in acres. Computation of each input is described below:

1) Runoff coefficients were estimated based on primary land use in each drainage area from

Table 9.4.1 in Handbook of Hydrology (Maidment). Primary land use was determined using visual inspection of aerial photography.

2) Rainfall intensity was determined using the National Weather Service's HDSC Precipitation Frequency Data Server for Illinois which is available on the web at http://hdsc.nws.noaa.gov/hdsc/pfds/orb/il_pfds.html. The design storm duration (time of concentration) was assigned as 10 minutes for drainage areas with primarily developed land uses and 15 minutes for primarily undeveloped land uses.

3) Drainage areas were computed with ArcGIS.

Attachment N3

Tables 4.12-3 and 4.12-4

Attachment N3

Table 4.12-3, as follows, provides a summary of the effects on upstream drainage areas from each connection alternative.

Table 4.12-3. Changes in Drainage Areas from Proposed Connections						
Construction Site	Affected Downstream Waterbodies	Affected Upstream Waterbodies	Existing Affected Down-stream Hydraulic Structure	Upstream Drainage Area Effects (Square Miles)		
				Existing Drainage Area	Construction Drainage Area[a]	Disconnected Drainage Area
No-Build at Munger	Pickerel Lake	Brewster Creek, unnamed stream	Bridge no. 124, unknown [b]	4.818	0.000	0.000
Proposed Munger Connection	Pickerel Lake	Brewster Creek, unnamed stream	Bridge no. 124, unknown [b]	4.818	0.086	4.732
Munger Connection - Original Proposal	Pickerel Lake	Brewster Creek, unnamed stream	Bridge no. 124, unknown[b]	4.818	0.080	4.738
Munger Alternative - UP Connection	Brewster Creek tributary	Local drainage	UP Bridge (no. unknown)	3.766	0.005	3.761
Munger Alternative - Northwest Quadrant	Pickerel Lake	Unnamed stream	Unknown [b]	0.364	0.268	0.096
No-Build at Joliet	Illinois and Michigan Canal	Local drainage	Bridge no. 201	0.807	0.000	0.000
Proposed Joliet Connection	Illinois and Michigan Canal	Local drainage	Bridge no. 201	0.807	0.002	0.805
Joliet Alternative - Original Proposal	Illinois and Michigan Canal	Local drainage	Bridge no. 201	0.807	0.001	0.806
No-Build at Matteson	Unnamed wetland, unnamed stream	Unnamed stream	Bridge no. 266	0.024	0.000	0.000
Proposed Matteson Connection	Unnamed wetland, unnamed stream	Unnamed stream	Bridge no. 266	0.024	0.002	0.022
Matteson Alternative - Northeast and Southwest Quadrants	Unnamed wetland	Local drainage	Bridge no. 265	0.015	0.003	0.012
Matteson Alternative - Southwest Quadrant	Local drainage	Local drainage	Bridge no. 264	0.002	0.002	0.000

Table 4.12-3. Changes in Drainage Areas from Proposed Connections						
Construction Site	Affected Downstream Waterbodies	Affected Upstream Waterbodies	Existing Affected Down-stream Hydraulic Structure	Upstream Drainage Area Effects (Square Miles)		
				Existing Drainage Area	Construction Drainage Area[a]	Disconnected Drainage Area
No-Build at Griffith	Unnamed wetland [c]	Unnamed wetland [c]	None	0.024	0.000	0.000
Griffith Connection	Unnamed wetland [c]	Unnamed wetland [c]	None	0.024	0.011	0.013
No-Build at Ivanhoe	Unnamed wetland	Local drainage	None	0.009	0.000	0.000
Ivanhoe Connection	Unnamed wetland	Local drainage	None	0.009	0.005	0.004
No-Build at Kirk Yard	Grand Calumet River	Local drainage	None	0.013	0.000	0.000
Kirk Yard Connection	Grand Calumet River	Local drainage	None	0.013	0.000	0.013

Notes:

[a] Assumes no new hydraulic structures constructed in proposed embankments. (See Table 4.12-4 for hydraulic structures necessary to maintain hydrologic conditions.)

[b] Structure is on CN rail line; further analysis forthcoming.

[c] The affected water body is bisected by the proposed embankment.

Table 4.12-4, as follows, summarizes the results of this analysis.

Table 4.12-4. Estimated Hydraulic Structures Required To Maintain Existing Hydrologic Conditions					
Site	Estimated Required Hydraulic Structures[a]	Affected Downstream Waterbodies	Affected Upstream Water body	Existing Affected Downstream Hydraulic Structure	Estimated Maximum Size
Proposed Munger Connection	1	Pickerel Lake	Unnamed stream	Unknown [b]	24
	1	Pickerel Lake	Brewster Creek	Bridge No. 124	48
Munger Connection-Original Proposal	1	Pickerel Lake	Unnamed stream	Unknown [b]	24
	1	Pickerel Lake	Brewster Creek	Bridge No. 124	48
Munger Alternative - UP Connection	Build new bridge that does not cause rise in flood water elevation.				
Munger Alternative - Northwest Quadrant	Maintain or expand the existing structures; no new structures required.				
Proposed Joliet Connection	1	Illinois and Michigan Canal	Local drainage	Bridge No. 201	Insufficient information[e]
Joliet Alternative - Original Proposal	1	Illinois and Michigan Canal	Local drainage	Bridge No. 201	Insufficient information[e]

Table 4.12-4. Estimated Hydraulic Structures Required To Maintain Existing Hydrologic Conditions					
Site	**Estimated Required Hydraulic Structures[a]**	**Affected Downstream Waterbodies**	**Affected Upstream Water body**	**Existing Affected Downstream Hydraulic Structure**	**Estimated Maximum Size**
Proposed Matteson Connection	2	Unnamed wetland, unnamed stream	Unnamed stream	Bridge No. 266	30
Matteson Alternative - Northeast and Southwest Quadrants	2	Unnamed wetland	Local drainage	Bridge No. 265	36
Matteson Alternative - Southwest Quadrant	No drainage area impacts; no new structures required.				
Griffith Connection	1	Unnamed wetland [b]	Unnamed wetland [c]	None	Insufficient information[e]
Ivanhoe Connection	1	Unnamed wetland	Local drainage	None	Insufficient information[e]
Kirk Yard Connection	No drainage area impacts; no new structures required.				

Notes:

a

b The affected water body is bisected by the proposed embankment.

c Due to geometry of the proposed alternatives, more than one structure upstream of the affected downstream water body may be required to maintain existing drainage areas.

d Structure is on CN rail line; insufficient structure information available.

e Neither detailed contour information nor upstream structure details exist to provide estimates of required hydraulic structure sizes.